

CLAIMS

1. A method for configuring the radiation characteristics of an antenna, characterised in that it comprises the steps of:

5 - including in said antenna (A) a plurality of radiating elements,

- associating to each of said radiating elements at least a respective signal processing chain, including in said respective chain:

10 - at least one module for weighting digital signals (34a, 34b, 34c, 34d; 36a, 36b, 36c, 36d) capable of applying to a digital signal at least a respective weighting coefficient, and

15 - at least one antenna conversion set (14 to 20; 20 to 26) interposed between said module for weighting digital signals and one of the radiating elements of the antenna, said antenna conversion set being configured to operate on digital signals on the side of said respective weighting module and on analogue signals on the side of the antenna element, and

20 - causing the propagation of a signal distributed on the processing chains associated to said plurality of radiating elements of the antenna (A), by applying respective weighting coefficients to said digital signal weighting modules (34a, 34b, 34c, 34d; 36a, 36b, 36c, 36d), said weighting coefficients 25 determining the radiation diagram of the antenna.

25 2. A method as claimed in claim 1, characterised in that it comprises the step of including in said signal processing chains first (34a, 34b, 34c, 34d) and second (36a, 36b, 36c, 36d) modules for weighting 30 digital signals as well as first (14 to 20) and second (20 to 26) antenna conversion sets, said first

weighting modules (34a, 34b, 34c, 34d) and antenna conversion sets (14 to 20) operating on the signal propagated towards said radiating elements of the antenna (A), said second weighting modules (36a, 36b, 5 36c, 36d) and antenna conversion sets (20 to 26) operating on the signal propagated starting from said radiating elements of said antenna (A).

3. A method as claimed in claim 2, characterised in that it comprises the step of applying to said 10 first weighting modules (34a, 34b, 34c, 34d) and to said second weighting modules (36a, 36b, 36c, 36d) weighting coefficients wherein said radiation diagram applied by said antenna to said signal is equal both for the signal propagated towards said antenna (A) and 15 for the signal propagated starting from said antenna (A).

4. A method as claimed in claim 2, characterised in that it comprises the step of applying to said first weighting modules (34a, 34b, 34c, 34d) and to 20 said second weighting modules (36a, 36b, 36c, 36d) weighting coefficients wherein said radiation diagram applied by said antenna to said signal is different for the signal propagated towards said antenna (A) and for the signal propagated starting from said antenna 25 (A).

5. A method as claimed in claim 1, characterised in that it comprises the step of including in said antenna conversion set at least a conversion function (16, 24) operating between the radio frequency (RF) 30 and the base band (BB).

6. A method as claimed in claim 1, characterised in that it comprises the step of including in said antenna conversion set at least a conversion function (16, 24) operating between the radio frequency (RF) 35 and the intermediate frequency (IF).

7. A method as claimed in claim 2, characterised in that it comprises the step of associating to said first (14 to 20) and second (20 to 26) antenna conversion sets signal distribution elements (20) 5 capable of operating both on a signal propagated towards said antenna (A) and on a signal propagated starting from said antenna (A).

8. A method as claimed in claim 7, characterised in that it comprises the step of choosing said signal 10 distribution elements (20) in the group constituted by radio frequency duplexers and switches.

9. A method as claimed in claim 1, characterised in that it comprises the steps of:

- generating (32) a plurality of replications of 15 a signal to be fed towards said antenna (A), and - sending said replications of the signal on respective processing chains associated to said radiating elements of the antenna.

10. A method as claimed in claim 1, characterised 20 in that it comprises the step of collecting (32) the components of a signal received starting from said antenna (A) and distributed on said respective processing chains by forming a single signal from said components.

25 11. A method as claimed in claim 1, characterised in that it comprises the steps of:

- incorporating in said distributed signal the information pertaining to said weighting coefficients, and

30 - extracting said weighting coefficients starting from said signal in view of their application to said weighting modules (34a, 34b, 34c, 34d; 36a, 36b, 36c, 36d).

35 12. A method as claimed in claim 1, characterised in that it comprises the step of associating to the antenna a module (DDL-A) for converting the signal,

which propagates on said processing chains associated to said radiating elements of the antenna, between an optical format and an electrical format (10, 30), so that said signal is capable of being transmitted with 5 respect to said antenna in optical format.

13. A method as claimed in claim 12, characterised in that it comprises the step of including in the signal propagated in optical format the information about said weighting coefficients 10 applied to said digital signal weighting modules (34a, 34b, 34c, 34d; 36a, 36b, 36c, 36d).

14. A method as claimed in claim 1, characterised in that it comprises the step of placing said processing chains associated to said radiating 15 elements of the antenna in close proximity to the antenna (A) itself.

15. Antenna with configurable radiation characteristics, characterised in that it comprises:

20 - a plurality of antenna radiating elements, and
- associated to each of said radiating elements, at least a respective signal processing chain, the processing chain in turn comprising:

25 - at least one digital signal weighting module (34a, 34b, 34c, 34d; 36a, 36b, 36c, 36d) capable of applying to a digital signal at least a respective weighting coefficient, and

30 - at least one antenna conversion set (14 to 20; 20 to 26) interposed between said module for weighting digital signals and one of the radiating elements of the antenna, said antenna conversion set being configured to operate on digital signals on the side of said respective weighting module and on analogue 35 signals on the side of the antenna element,

the arrangement being such that the weighting coefficients applied to said digital signal weighting modules (34a, 34b, 34c, 34d; 36a, 36b, 36c, 36d) determine the radiation diagram of the antenna (A).

5 16. Antenna as claimed in claim 15, characterised in that said signal processing chains comprise first (34a, 34b, 34c, 34d) and second (36a, 36b, 36c, 36d) digital signal weighting modules as well as first (14 to 20) and second (20 to 26) antenna conversion sets, 10 said first weighting modules (34a, 34b, 34c, 34d) and antenna conversion sets (14 to 20) operating on a signal propagated towards said radiating elements of the antenna (A), said second weighting modules (36a, 36b, 36c, 36d) and antenna conversion sets (20 to 26) 15 operating on a signal propagated starting from said radiating elements of said antenna (A).

17. Antenna as claimed in claim 16, characterised in that it comprises at least one weighting control block (46) configured to apply to said first weighting 20 modules (34a, 34b, 34c, 34d) and said second weighting modules (36a, 36b, 36c, 36d) weighting coefficients wherein said radiation diagram applied by said antenna to said signal is equal both for the signal propagated towards said antenna (A) and for the signal 25 propagated starting from said antenna (A).

18. Antenna as claimed in claim 16, characterised in that it comprises at least one weighting control block (46) configured to apply to said first weighting modules (34a, 34b, 34c, 34d) and said second weighting 30 modules (36a, 36b, 36c, 36d) weighting coefficients wherein said radiation diagram applied by said antenna to said signal is different for the signal propagated towards said antenna (A) and for the signal propagated starting from said antenna (A).

35 19. Antenna as claimed in claim 15, characterised in that said antenna conversion set comprises at least

one frequency converter (16, 24) operating between the radio frequency (RF) and the base band (BB).

20. Antenna as claimed in claim 15, characterised in that said antenna conversion set comprises at least 5 one frequency converter (16, 24) operating between the radio frequency (RF) and the intermediate frequency (IF).

21. Antenna as claimed in claim 16, characterised in that to said first (14 to 20) and second (20 to 26) 10 antenna conversion sets are associated signal distribution elements (20) capable of operating both on a signal propagated towards said antenna (A) and on a signal propagated starting from said antenna (A).

22. Antenna as claimed in claim 21, characterised 15 in that said signal distribution elements (20) are chosen in the group constituted by radio frequency duplexers and switches.

23. Antenna as claimed in claim 15, characterised in that it comprises a distributing element (32) 20 configured to:

- generate a plurality of replications of a signal to be fed towards said antenna (A), and
- sending said replications of the signal on respective processing chains associated to said 25 radiating elements of the antenna.

24. Antenna as claimed in claim 15, characterised in that it comprises a collecting element (32) configured to collect the component of a signal received starting from said antenna (A) and 30 distributed on said processing chains associated to said radiating elements of the antenna.

25. Antenna as claimed in claim 15, characterised in that it comprises an extraction module (46) configured to extract said weighting coefficients in 35 view of the application to said weighting modules

(34a, 34b, 34c, 34d; 36a, 36b, 36c, 36d) starting from said signal.

26. Antenna as claimed in claim 15, characterised in that said processing chains associate a said 5 radiating elements of the antenna are located in close proximity to the antenna (A) itself.

27. An apparatus comprising an antenna as claimed in one of the claims 15-26, characterised in that to the antenna is associated:

10 - an electro-optical converter module (DDL-A) configured to convert the signal, that propagates on said processing chains associated to said radiating elements of the antenna, between an optical format and an electrical format (10, 30).

15 28. An apparatus as claimed in claim 27, characterised in that said electro-optical converter module (DDL-A) has associated an extraction module (46) configured to extract said weighting coefficients in view of the application to said weighting modules 20 (34a, 34b, 34c, 34d; 36a, 36b, 36c, 36d) starting from said optical signal.

25 29. Radio base station comprising an apparatus as claimed in claim 27 or 28, characterised in that it comprises a control unit (CU) and an optical link (F) for the transmission of an optical signal between said control unit and said electro-optical converter module (DDL-A) associated to said antenna.

30 30. Radio base station as claimed in claim 29, characterised in that said control unit comprises a function block (BS1) that is able to generate an information signal and a signal for controlling the radiation diagram of the antenna.

35 31. Telecommunications network comprising at least an antenna as claimed in any of the claims 15 to 26.

32. Data processing product capable of being loaded into the memory of at least an electronic device and comprising portions of software codes for implementing the method as claimed in any of the 5 claims 1 through 14.